Standard-Model Tests with Superallowed β Decay: Nuclear Data Applied to Fundamental Physics

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Superallowed nuclear β decay is a sensitive probe of the Electroweak Standard Model. The strength (ft-value) of a superallowed β transition between 0^+ analog states yields a direct measure for the vector coupling constant, G_V. Comparison of results for G_V obtained from such transitions over a wide range of nuclei tests the conservation of the vector current (CVC), and comparison of the nuclear result with those obtained from the weak decays of K and B mesons tests another fundamental tenet of the Standard Model: the unitarity of the Cabibbo-Kobayashi- Maskawa (CKM) matrix. Current world data support CVC at the 0.04% level but show a 2.3σ deviation from CKM unitarity of 0.32%. This latter discrepancy could indicate the need for new physics and its discovery has stirred considerable activity directed at reducing the experimental uncertainties and arriving at a more statistically definitive result.

Any ft-value depends on three measured quantities: the Q-value, half-life and branching-ratio for a particular β transition. To contribute usefully to the CKM unitarity test, an ft-value must be determined to $\sim$0.1%, which means that each of its three component quantities must be determined even more precisely. This demands that metrological techniques, in some cases with unprecedented precision, be applied to short-lived ($\sim$1s) activities; and that strict standards be employed in surveying the body of world data. The talk will overview the current status of these important tests, describe current experimental activity and indicate where broader nuclear data can play a key role.

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